ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 02 | February - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

BURIED STRIP URETHROPLASTY- REGENERATIVE PRINCIPAL REVISITED- PROMISING RESULT IN HYPOSPADIAS REPAIR.

Urology

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ABSTRACT

Synopsis More than 250 types of surgeries for hypospadias repair is described in literature and the sheer number of it gives an idea about the difficulties in hypospadias repair.Broadly, these surgeries can be classified as tubularised or detubularised repair techniques of hypospadias. In the current times, tubularised techniques have been more popular although it has its own share of disadvantages and failure rates. **Objective:** In this article we are describing a regenerative - nontubularised technique of hypospadias repair based on buried strip principle done on 21 hypospadiac patients and the results have been very encouraging. **Methods:** 21 hypospadiac patients were included in this study who had glanular/subcoronal, Distal penile or mid penile hypospadias. Among these 5 were a redo hypospadias repair surgery. **Results:** overall significant complication rate in our study was 19%. 2 patients (9.5%) needed further surgical intervention in our study. One patient developed scrotal hematoma, and another patient developed superficial epithelial blackening and skin loss. Urethrocutaneous fistula developed in 5 patients, 4 of them got corrected just by regular meatal calibration, and one patient needed needling. **Conclusion:** We found nontubularised regenerative buried strip urethroplasty to be an easier, simple and effective technique to correct hypospadias with promising results, atleast for anterior and penile hypospadias till now. Results for more complex posterior cases with significant chordee are under study at present.

KEYWORDS

Hypospadias, Regeneration, Nontubularised, Buried strip, Urethroplasty

INTRODUCTION:

More than 250 types of surgeries for hypospadias repair is described in literature and the sheer number of it gives an idea about the difficulties in hypospadias repair.(1)(2).

In recent times Tubularised urethroplasty has gained popularity , in spite of the overall complication rates which varies between 0% to 50 % (3),(4).

With tubularisation, the vascular supply may be compromised because of circumferential lifting off the urethra from subcutaneous tissue. Not only that, further vascularity may be compromised when the stitches are given to create neo-urethra. Moresoever if the tubularisation is in tension might cause healing by desmoplastic (fibrotic) reaction along the suture lines(5). In follow up we experienced less compliant neo-urethral tubes which needed long durational dilation to get adequate flow. Sometimes resistance of flow through neo-urethra causes increased bladder wall thickness in USG, leading to compensatory changes in the urinary bladder and bladder neck region.

Many authors are proponent of a minimum width of 8 mm for tubularisation (6,7). For narrow urethral plate or in re-operative cases where urethral plate is minimal, tubularisation leads to higher failure/complication rate.

Now question is ,Tubularisation is necessary or not?- Tubularised incised plate (Snodgrass) is one of the most famous technique in hypospadias surgery which depends on tubularisation of urethral plate (3), but, Actually it is incomplete tubularisation as it keeps the dorsal incised portion raw and allow regeneration of epithelium in that cleft. So, the concept is of urethral regeneration in the incised cleft , as described by Weaver, Schulte and Moore (8).

We further realise that even popular non-tubularised techniques like Johansen's urethroplasty also relies on regeneration of urethra for adequate tubularisation. Thus clearly regeneration plays a massive role for neo-urethra formation. The regeneration of an entire urethra over a splinting catheter is possible with 3 to 4mm of urethral plate (9, 8).

There are studies which favours regenerative urethroplasty following the principle of “buried strip concept”, which was first popularised by Denis Browne(10).

Similarly, in our study, we have used the nature's regenerative phenomenon to create neourethra based on “buried strip principle”. Skin have basal cell layer which nests stem cells, So, it has got enormous growth potential (11). So, strip of epithelial tissue comprising urethral plate is kept under the coverage of the dartos fascia which then regenerates and grows to form neourethra using the foley's tube placed there as a scaffold.

In this article we are describing our technique, outcomes and results in 21 patients who underwent buried strip urethroplasty along with ventral wrap of Tunica vaginalis pedicled flap to increase vascularity around reconstruction.

For better assessment of this technique as a preliminary study and simplicity we have excluded all cases with chordee more than 30 degree, posterior hypospadias/ complex genitalia cases. Only mid and distal penile cases were included. Chordee lesser than 30 degree were another criteria for inclusion.

Owing to the encouraging results of this study, another study on complex cases of posterior hypospadias with significant chordee is ongoing in our department of urology. These cases are being done with same technique and principles but in 2 stages of repair (12).

We used TV flap as there are many comparative studies establishing TV flap to be superior than other flaps like dartos, scrotal flaps (13), (14).

MATERIALS AND METHODS:

Total of 21 hypospadiac patients were enrolled in this study after taking an informed consent in our Dept. of Urology, NRSMC&H, Kolkata.

Inclusion criteria

- Distal and mid-penile hypospadiac patients with minimal to no chordee

Exclusion criteria

- Proximal penile, penoscrotal, scrotal/ complex genitalia patients were excluded.
- Those patients with significant chordee (more than 30 degree) were excluded.

Study design:
All eligible patients underwent buried strip hypospadias repair. All patients who were previously operated and had failed repair were given a minimum of 6 month healing period before this surgery.

In post-op, tube was kept for 2 weeks for fresh cases and 3 weeks for redo cases.

After removal of tube, all patients were advised urethral calibration daily with suitable size meatal dilator.

Follow-up was done at 1, 3,6,12 months.

At each follow up, **subjective assessment** was done by - history regarding stream of urine, straining during micturition was taken and examined for positon of meatus, shape of glans & chordee. For better assessment we asked the parents/patients to bring video of voiding urinary flow in their cell phones.

Objective assessment:
1. Uroflowmetry. Since there is no nomogram for kids for uroflowmetry, under 2nd standard deviation patients were considered normal, provided there is no straining and maximum flow rate more than 10ml/sec.
2. USG was done for patients who had straining during micturition. All the data were recorded and analysed on Microsoft excel sheet.

Operative steps:
As most patients were of younger age (range: 3-26 years), general anaesthesia was preferred. After a glanular stay suture taken in long axis for better manipulation of penis during surgery (fig 1), an appropriate size catheter is placed in the bladder through hypospadiac meatus and secured to the glans with traction sutures.

Fig 1: stay sutures taken , coronal hypospadias.

Then, a "U" shaped incision is made ventrally such that the lower end of "U" just encompasses the hypospadiac meatus and both the upper end of incision reaches till the glanular cleft meatus. At this stage the plate typically measures 4 to 8 mm in width and appear flat. Both the upper ends of "U" on ventral side are curved laterally along the demarcation of prepuce and penile skin and joined as a circumcoronal incision on the dorsum for degloving of penis.

The penile skin is then degloved above the buck's fascia layer identified by neurovascular bundles. This basically leaves a rectangular strip of urethral plate from hypospadiac meatus up to the glans separate from rest of the penile skin after degloving (Fig 2). Hemostasis is achieved by bipolar diathermy or gentle pressure.

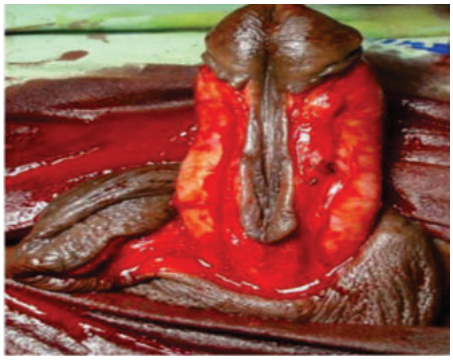

Fig 2: urethral plate with skin margin (buried strip) after degloving

A midline incision is made on the separated urethral plate with skin margin, i. e buried strip. This helps in accommodating the catheter without giving tension on suture lines of the glanuloplasty done later in the procedure. (Fig 3).

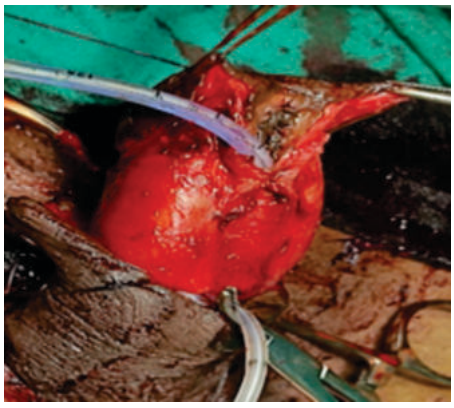

Fig 3: After foleys is passed through the hypospadiac meatus.

Now, tunica vaginalis pedicled flap is harvested by bringing the testis of one side out by extension of same incision (fig 4).

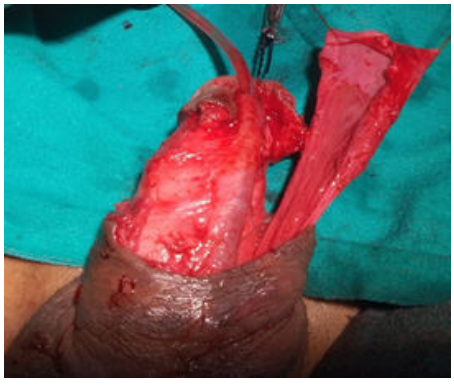

Fig 4: Right TV flap harvested.

Care is taken that the flap width is enough to easily cover whole of buried strip around and length is enough to reach up to the tip of glans. This flap is now sutured to the tip of glans and around the buried strip and proximal penile urethra with corpora spongiosa (intermittent sutures with 5-0 PDS), so that it just wraps the entire length for better vascularisation.

Glanuloplasty is done by 1st raising the glans wings, then after foley's is passed through the meatus and over it tunica vaginalis flap is once placed, this raised glans wing are sutured subcuticularly over the TV flap in midline (fig 5).

Fig 5: Raised glans wings.

To approximate the coronal margin, two to three stitches placed between the coronal margin and meatus provide adequate separation of these structures for optimal cosmetic results. The mucosal collar is approximated to mimic the frenulum. The skin closure is completed

with a variation of byer's flaps to create a median raphe ventrally. To minimise the risk of suture tracts all skin stitches are sutured by sub-epithelial technique.

Catheter is then fixed with the glans stay suture taken earlier so that it remains in situ in post op period.

Modified sunflower dressing with mupirocin ointment in emollient base as first layer is done. In modified sunflower dressing, after wrapping of the penis with ointment and gauze pieces, and secured with adhesive tapes all round, the dressed penis is then compressed over anterior abdominal wall to prevent oedema and hematoma. Special care is needed to also give a slight compressive dressing to scrotum. Dressing is removed on post-op day 3 after saline soaking it for half an hour.

RESULTS:

Our patients: Total of 21 patients of hypospadias patient were taken in our study.

The mean age was 13 years (ranging 3-26 years). 5 patients (23.8%) had a history of previous hypospadiac correctives surgery, which obviously failed, with different techniques like TIP, penile skin graft, Mathieu flip flap, lingual graft etc. (Fig 6)

Fig 6: cases

Distal penile hypospadias was seen in 10 patients, 8 patients had glanular/subcoronal hypospadias while 3 patients had mid-penile hypospadias (Fig 7).

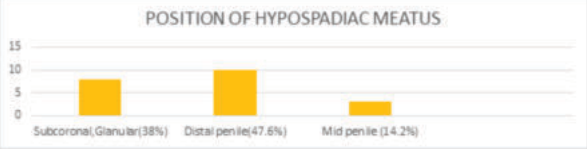

Fig 7: Position of hypospadias.

Urethral plate was normal or atleast ventral skin was intact in atleast 16 patients and 3 patients had multiple fistulas. Average width of urethral plate ranged between 3-7 mm. Minimal chordee was seen in 8 of the patients, which itself got corrected on degloving.

Our outcomes:

After the surgery, the mean follow-up period was of 12.4 months (ranging between 3 to 26 months). 20 patients maintained the normal position and shape of the neomeatus and glans structure with 13 patients (62%) having vertical slit meatus, which is an encouraging cosmetic result. One patient had wound dehiscence and needs another surgery. None of our patients had any changes in bladder wall.

In post op period after removal of urethral tube, Suture track urethra-cutaneous fistula occurred in 5 patients (24%), out of which 4 patients improved and subsequently had single urinary stream with only regular urethral calibration with appropriate size meatal dilators which is anyways advised in all our patients. One patient with suture track fistula did-not resolve till 6 months and needed needling (15).

Another patient which needs re-intervention has developed multiple urethra-cutaneous fistula who had developed SSI and wound dehiscence in post-op period.

So out of 21 patients, 2 patients (9.5%) needed further surgical intervention in our study. One patient developed scrotal hematoma, which was managed conservatively and another patient developed superficial ventral skin loss, managed conservatively with dressing and colloid silver hydrogel ointment (Fig 8). Therefore, significant overall complication rate in our study was 19% which is comparable with other studies (1).

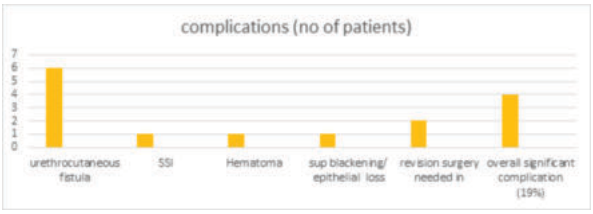

Fig 8: Complications

All but one patient had satisfactory urinary passage in our study with uroflowmetry parameters suggesting them to be within 2nd std deviation. There was no back pressure changes in upper urinary tract on USG in any of the patient. None of our patients had the need to undergo RGU/urethroscopy for stricture/obstructive outflow.

DISCUSSION:

Buried strip urethroplasty is a non-Tubularised urethroplasty technique first described by Dupley in 1880 but was popularised by Denis Browne in 1949 (10 ,1). But in recent times this technique has gone into oblivion. The principle of this technique is based on regeneration of tissues from basal layer of skin.

In recent times, with advent of stem cell therapies, lots of interest in regenerative principles have come to the fore. Buried strip (island of skin and urethral plate between hypospadiac meatus and tip of penis) is left intact and in situ and kept buried under a tube. The epithelial margins of the strip then regenerates around the tube forming neourethra using the tube as a scaffold. For this regeneration of epithelial margins, the vascular supply is further augmented and made conducive with the help of a pedicled tunica vaginalis flap (TV FLAP) which helps in vascularisation(1).

Though the magnitude of regenerative potential of epithelial tissue in subcutaneous adipose tissue is not yet exactly quantified ,But by knowledge of modern tissue engineering we know that, it is possible to get a football field size epithelial tissue from a piece of one square cm within 8 weeks [16]. Regeneration may even be possible from the fibrosed urethra as their cells retain the genetic stability.(17)

This non tubularised technique leaves the urethral plate in situ, and as there is no mobilisation of urethral plate, there is no damage caused to its vascularity during repair. Owing to non-tubularisation, the tension-less stitching avoids the tension-blanching-ischemia-fibrosis cascade. Further vascularisation was supported by the pedicled tunica vaginalis flap(18) .

High failure rate of Denis Browne buried strip made it oblivious in contemporary world, which could be owed to overlapping midline suturing of urethra and skin. To obviate that problem Durham Smith (1973) conceptualized the barrier layer, i.e., “pant over vest”,to avoid the overlapping of the suture lines of urethra and skin to minimize occurrence of urethro-cutaneus fistula(19).

We avoided it, by giving a waterproof cover in between skin and urethral plate with tunica vaginalis pedicled flap. Basavaraju et al in their study compared fistula rate between dorsal dartos fascia, ventral dartos fascia and TV flap as barrier layer between urethral suture line and skin suture line and reported fistula rate as 22%, 14% and 0 % respectively(20). Many other studies have reported better results with TV flap hence we used TV flap as barrier layer between the urethral and skin suture lines.

The limitation of this study is that only distal and mid-penile hypospadiac patients were included in study, and more complex cases like proximal and scrotal hypospadias were excluded. Another study involving these patients are currently under study with same surgery being done in 2 stage. The preliminary results are encouraging, while we are waiting for final results after 1 year of follow-up.

The present study is also limited by: its retrospective design; the multiple surgeons that were involved, however, all were qualified urologists with a sufficient degree of expertise;

and overlap between dates of surgeries.

CONCLUSION:

The concept of buried strip urethroplasty is an old, abandoned and unknown to many in contemporary world even to the tune of oblivion, but with newer interests in stem cells and regeneration its time to further explore this forgotten principle.

Some of the popular urethroplasties like Snodgrass, Johansen's urethroplasty also in fact uses this same regenerative principles. The cleft following incision on the urethral plate is actually depending on regeneration of urethra in Snodgrass, TIP urethroplasty.

We are using this regenerative capacity of urethral plate edges which has been incised and separated from rest of penile skin by degloving. This urethral plate edge regenerates and form the neo-urethra circumferentially over the silicone Foley's catheter being used as a scaffold. We found non-tabularised regenerative buried strip urethroplasty to be an easier, simple and effective technique to correct hypospadias with promising results, atleast for anterior and penile hypospadias till now. Results for more complex posterior cases with significant chordee are still awaited.

Conflict of interest: We have no conflict of interest to declare

Ethical: there is no ethical issue.

Source of funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not for- profit sectors"

Author's contribution:

Anupam anand conceived and designed the study, conducted research, provided research materials, and collected and organized data. He also wrote the initial draft

Rahul roy analysed and interpreted data.

Tapan kumar mandal compiled the final draft of article, and provided logistic support.

U.S chatterjee was also involved in compiling the final draft.

All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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